«Phase transformations, chemical reactions and melting properties investigated *in situ* using the laser heated diamond anvil cell»

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An intrinsic problem of cold compression in the diamond anvil cell (DAC) is the development of deviatoric stresses in the sample chamber. Also, most of phase transformations and, a fortiori, chemical reactions do not occur without providing energy to overcome the kinetic barriers. For example, a frequent observation is high-pressure amorphization, which yields to apparition of a metastable material instead of the transformation into a stable assemblage of phases.

For many years now, laser heating (LH) has been a tool of choice to investigate the material properties under high pressures. It can be used to release the deviatoric stresses, overcome the kinetic barriers and for *in situ* measurements of material properties in an extensive range of pressures and temperatures. Limitations are (i) temperatures below 1000 K, when the hot spot is difficult to detect using a classical optical system, (ii) low pressures, when the gasket remains weak (with a pressure limit depending on the type of DAC) and (iii) above 150-200 GPa, when the distance between the two diamond culets is smaller than ~5 µm.

In this presentation, we will present the basic of LH-DAC experiments, emphasizing on details that yield to proper or improper experimental conditions.

We will show that the ESRF beam-lines are exceptional tools to probe the sample properties *in situ* at high pressures and temperatures using the LH-DAC, using different approaches. We will present different examples of the monitoring of phase transformations, chemical reactions, measurements of P-V-T equations of state and melting properties. The *in situ* measurements using X-ray beams are also ideal to optimize the experimental conditions, before other types of LH-DAC experiments can be performed.